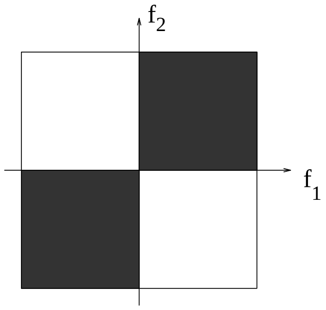
ELEC 539 Digital Image Processing
Assignment 3

Due: Wednesday 3 March 1999

1. **Fan Filter Design using Frequency Transformations.**

   We desire a filter approximating the following spatial frequency response:

   The filter response must approximate one in quadrants 1 and 3 (the shaded regions) and zero in quadrants 2 and 4 (the white regions). Such a filter is called a *fan filter* and proves useful in many applications, including geophysical data processing.

   (a) Explain why the frequency transformation

   $$\cos 2\pi f \;=\; \sin 2\pi f_1 \, \sin 2\pi f_2$$

   is appropriate for our purpose. (Hint: sketch it.)

   (b) Given this frequency transformation, what type of 1d filter must we design? Design an appropriate L_∞-optimal, 11-tap filter using the McClellan-Parks (Remez exchange) algorithm. See the matlab command `remez`.

   (c) Combining your results, plot the frequency response of the final fan filter.

   (d) Discuss the result of the transformation

   $$\cos 2\pi f \;=\; \frac{1}{2}\cos 2\pi f_1 - \frac{1}{2}\cos 2\pi f_2.$$

2. Dudgeon and Mersereau, Problem 3.18. Discuss the implications for filters designed using the McClellan transform.

3. With your study group, discuss and synthesize the major *themes* of this week of lectures. Turn in a one page summary of your discussion. You need turn in only one summary, but include the names of all group members. Please do not write up just a "table of contents."